March 15, 1938. L. F. PARKER 2,111,405

POWER MUCKING SHIELD

Filed Aug. 10, 1937 3 Sheets-Sheet 1

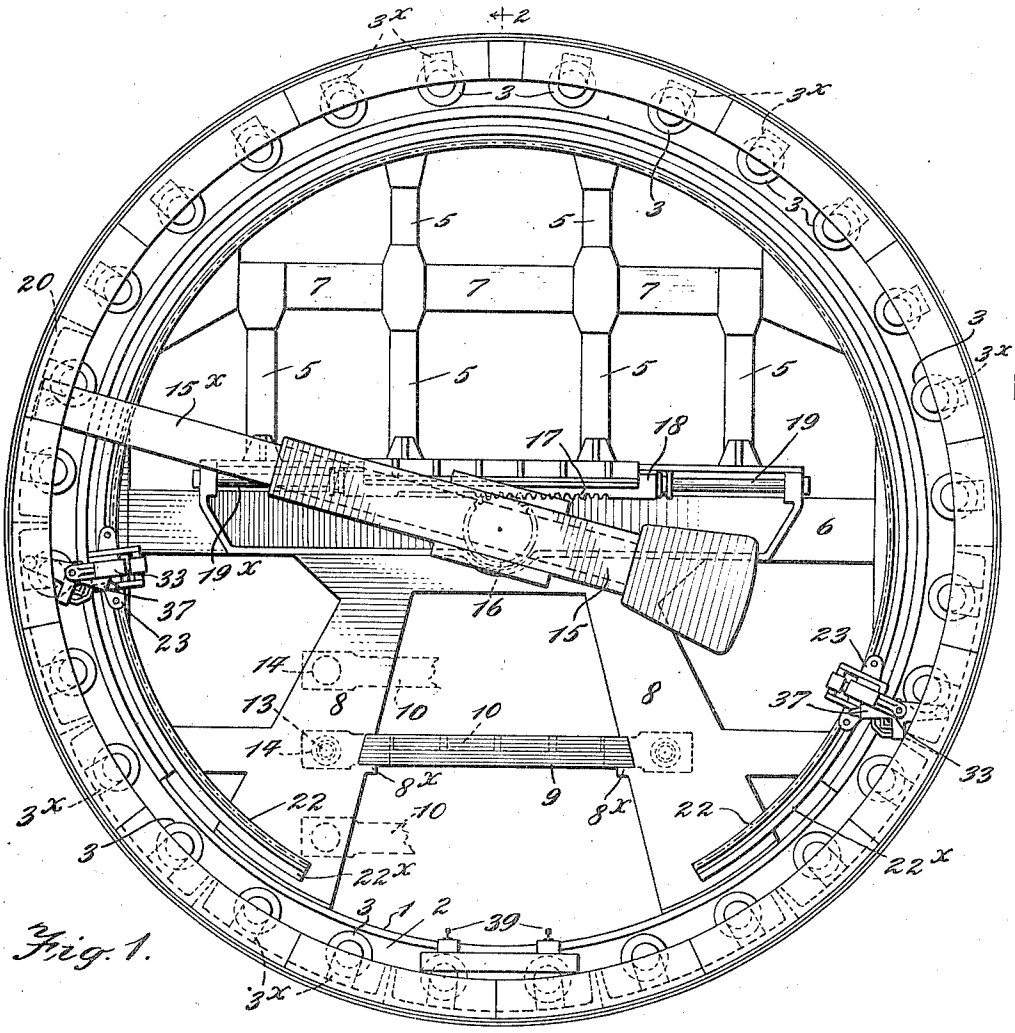


Fig. 1.

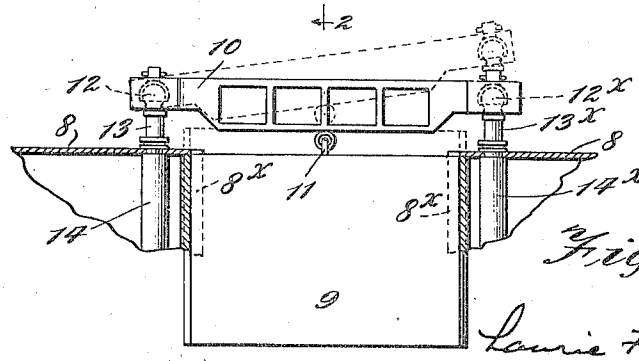


Fig. 4.

INVENTOR.
Laurie F. Parker

BY
H. Lee Helms
ATTORNEY.

March 15, 1938. L. F. PARKER 2,111,405

POWER MUCKING SHIELD

Filed Aug. 10, 1937 3 Sheets-Sheet 2

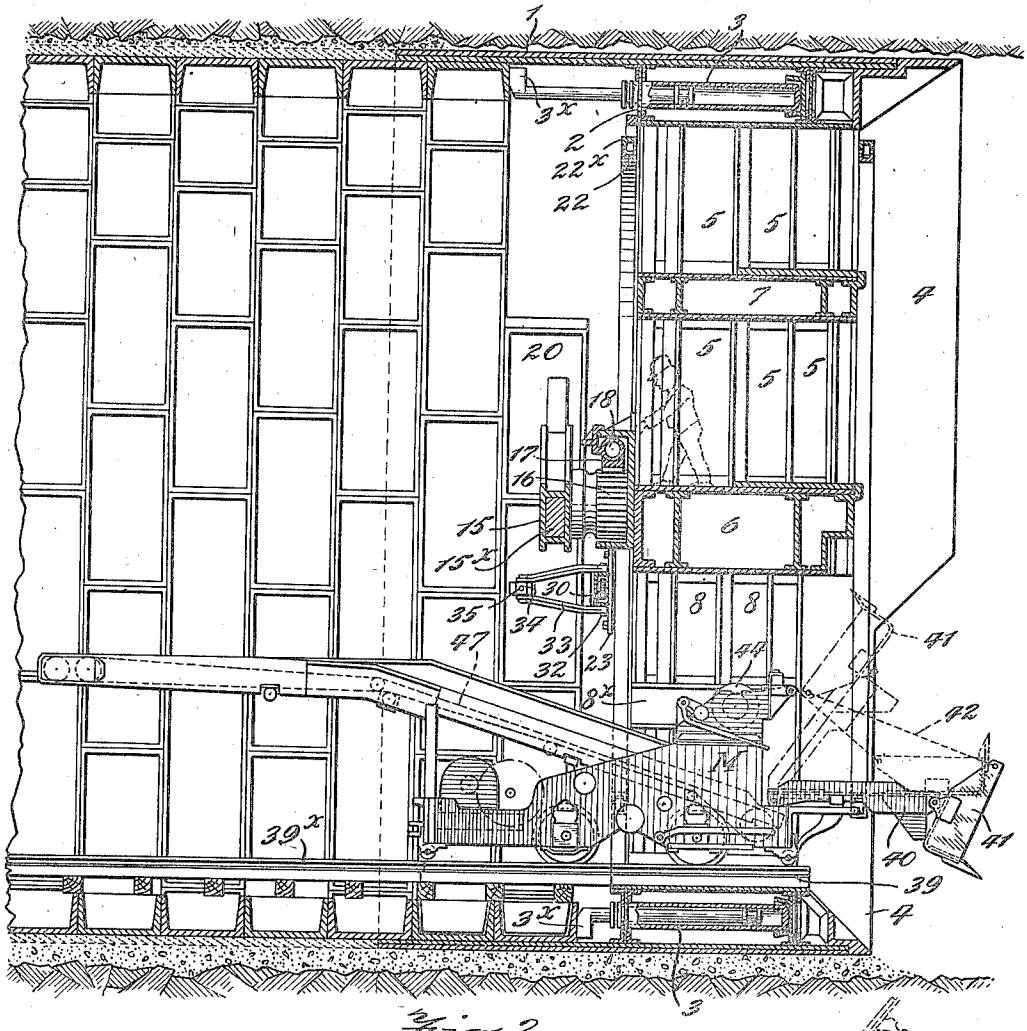


Fig. 2.

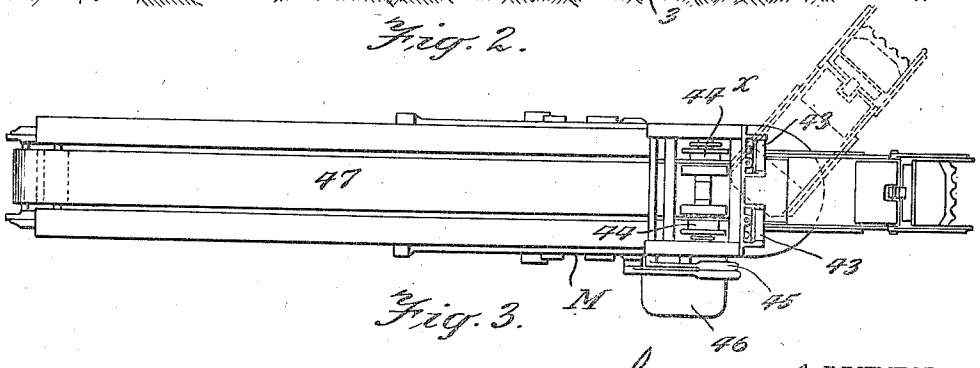


Fig. 3.

Louis F. Parker INVENTOR.

BY H. Lee Helms

ATTORNEY.

March 15, 1938. L. F. PARKER 2,111,405

POWER MUCKING SHIELD

Filed Aug. 10, 1937 3 Sheets-Sheet 3

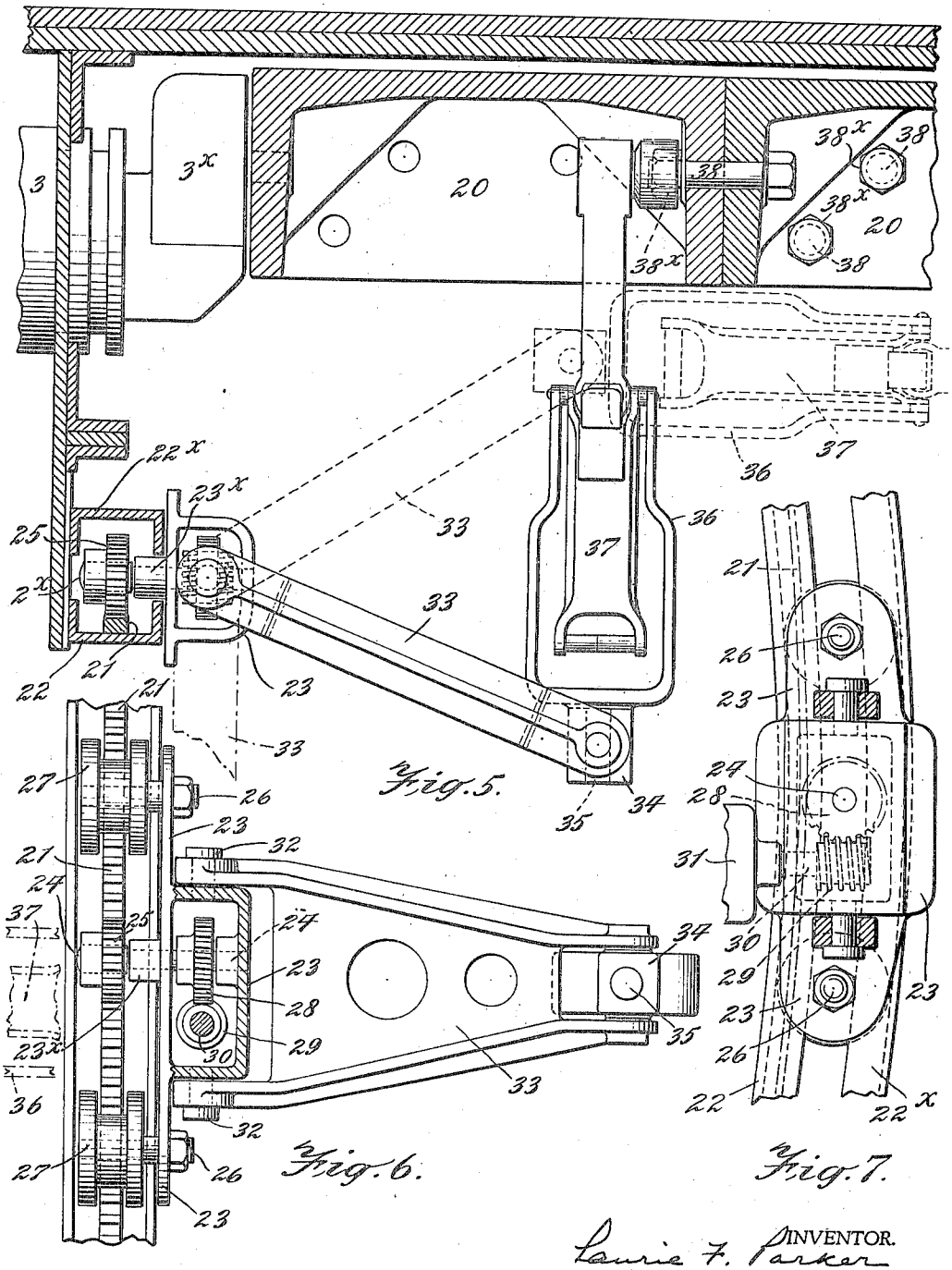


Fig. 5.

Fig. 6.

Fig. 7.

INVENTOR.
Laurie F. Parker

BY H. Lee Helms

ATTORNEY.

Patented Mar. 15, 1938 2,111,405

UNITED STATES PATENT OFFICE

2,111,405

POWER-MUCKING SHIELD

Laurie F. Parker, Noroton, Conn.

Application August 10, 1937, Serial No. 158,271

8 Claims. (Cl. 61—84)

In the construction of tunnels by power jack propelled shields having cutting faces, it is necessary to provide shields capable of withstanding great stresses. To this end the shield annulus is reinforced by means of heavy interior columns and girders, certain spaces between them serving as working pockets in which men conduct drilling, blasting and other operations. In the lower pockets it has been the uniform practice to employ successive gangs of men to shovel muck from the muck deposit, throwing it back of the shield for removal at such point, as by a power-boom mucker, into cars. As the shield advances the power mucker follows rearwardly of it, and its speed of operation is not only dependent upon the progress of the shield but upon the rapidity at which the shovel gangs shovel back the muck. The progress of the shield is incidentally dependent upon the erection and bolting of the rings of liner plates, which operations are performed from the shield, and the liner plates serve as backstops for the shield jacks.

It is the object of my invention to provide a method and a power mucking shield for use therein in which the shovel gangs, which operate under extremely hazardous conditions, may be eliminated, speed of operations increased and costs reduced, by the novel step of operating a power mucker forwardly of the shield. The power mucker may ride upon the shield itself in a special passageway formed therein, with the mucker boom projected forwardly thereof. The muck bucket may be upwardly swung into the shield from such point and the muck may be discharged by gravity onto a carrier therefor.

The practice of the method requires a novel and radical change in the form of the shield itself and in the preconceived and universally followed practices of tunnel construction.

In some cases, as where a rock face is met with, the power mucker may operate wholly ahead of the shield and the latter brought up in accordance with the speed at which the liner plates are erected and bolted together.

These and other objects will be described with reference to the accompanying drawings, in which:—

Figure 1 is a view in rear elevation of my shield adapted for use in the method, a removable breasting girder being shown in position.

Figure 2 is a longitudinal section of the same taken generally on the line 2—2, Figure 1.

Figure 3 is a plan view of the power mucker, shown in the preceding figure, in elevation.

Figure 4 is a plan view, partly in section, of the removable breasting girder, power jacks for operating the same, and a trailing platform connected to the girder.

Figure 5 is an enlarged vertical section through the rear face plate of the shield annulus, showing the rear portion of one of the jacks, the trackway and track housing for the bolt tightener bracket carrier, two tunnel liner plates being shown assembled and the bolt tightener in operative position relatively to a bolt therefor.

Figure 6 is a front face view of a fragment of a trackway showing the lower housing member therefor, also the bracket carrier, partly broken away, and the primary bolt tightener bracket in position.

Figure 7 is a side elevation of a fragment of the trackway housing with the carrier mounted in position, certain parts being shown in dotted lines and other parts in transverse section.

Referring to the drawings, I have shown the shield annulus at 1, the annulus having a rear face plate 2 affording one supporting member for a plurality of power jacks 3, each jack having a piston formed with an angularly extending piston head 3x. At the front face of the annulus the latter is formed with a cutting face 4.

The reinforcement for the shield comprises upper and lower columns and girders. The upper columns are shown at 5 and at their base they are immediately connected to the primary horizontal girder assembly shown at 6 which is formed of a series of connected plates as indicated more particularly in Figure 2. The upper columns 5 are reinforced by transverse girders 7 each made up of a plurality of connected plates as shown in Figure 2.

Intermediate the base of the annulus and the primary horizontal girder assembly 6 are two columns 8, each column being formed of a plurality of connected plates, the columns being inclined relatively to the primary girder assembly 6 so as to provide a passageway between them of greater width toward its base, the top of the passageway terminating adjacent the base of the primary girder assembly 6.

The inner face of each column 8 may be provided with a channel as indicated at 8x, Figure 4, to slidingly receive a removable platform 9 (Figures 1 and 2) forwardly of which is disposed a breasting girder 10 connected at 11 to the platform so that when the breasting girder is moved forwardly it will carry with it the said platform 9. At one end of the breasting girder it is connected by a ball and socket joint 12 with the piston 13 of a power jack 14 mounted in one of

the columns 8. At its opposite end the breasting girder is connected by ball and socket joint 12x with the piston 13x of a second power jack 14x carried by the second of the two primary columns 8. The breasting girder is thus adapted to serve as a breasting element when the shield passes into bad ground which is liable to cave in. Additional breasting girders and jacks may be employed as indicated by the dotted lines 10, Figure 1. These breasting girders and their trailing platforms are removable and are not used when the tunneling conditions do not require their use.

The primary girder assembly 6 is employed as a supporting medium for a tunnel liner erector comprising the weighted sleeve 15 which is pivotally carried by said girder assembly and has fixed thereto a pinion 16 engaged by a rack 17 carried by a cylinder 18 which is formed in two sections by a simple division wall (not shown). Into each section projects a fixed piston rod 19, 19x, so that when fluid under pressure is admitted into one section of the piston the rack will be moved in one direction, a reverse action taking place when fluid under pressure is admitted to the other section of the cylinder. This will cause the erector sleeve 15 to swing about its axis and thus position the erector arm 15x, which latter is adapted to reciprocate within sleeve 15, as by the use of fluid pressure within the sleeve.

The erector arm will carry a tunnel liner plate such as 20, Figures 1 and 2, to position for securing it by bolts to the pre-assembled ring of plates and to the adjacent plates of its own ring assembly.

To the annulus adjacent the rear face plate 2 thereof is secured a toothed trackway or rack 21 through the intermediary of one section 22 of a track housing, the second section of the housing being indicated at 22x, each housing section comprising a U-shaped plate, the flanges of which are spaced so as to provide clearance for the bearing hub 23x of a carrier 23. Through bearing hub 23x passes a shaft 24 which carries a pinion 25 in mesh with rack 21. Carrier 23 also carries two shafts 26 projecting between the housing plates 22 and 22x, each shaft carrying a double-flanged bearing wheel 27 which straddles the rack and bears upon the inner surfaces of the said housing plates 22, 22x.

Shaft 24 of carrier 23 has fixed thereon a worm wheel 28 in mesh with a worm 29 on a shaft 30 of motor 31 (Figure 7) mounted on the carrier. Thus when the motor is energized the carrier will move relatively to the rack, a reversible motor will be used to obtain the necessary movements of the carrier in opposite directions.

Mounted on pintles 32 of carrier 23 and adapted to swing relatively thereto is a primary bracket arm 33. At the end of the bracket arm opposite the pintles the latter pivotally carries a block 34 in which is swivelled pivot stud shaft 35 of a secondary bracket 36 formed as a yoke. The ends of the bracket yoke 36 are pivoted to the bolt tightening apparatus 37 midway of its length.

When a tunnel liner plate is to be bolted to a contacting plate of a previously erected ring of liner plates, the elements just described will lie in the position shown in Figure 5. In such position the bracket arm 33 projects outwardly from the trackway or rack housing 22, 22x, and the yoke 36 is swung at right angles to the said housing. In bolting a tunnel liner plate to an adjacent plate of the same ring or, in other words, in bolting the ends of two abutting tunnel liner plates together as by bolts 38, Figure 5, the bracket arm 33 is swung to the proper position and the yoke 36 turned on its swivel to give a like turning movement to the bolt tightener 37 to carry its nut receiving head into proper position relatively to the bolt and the nut 38x thereon. By reason of the double-bracket, swivel, and pivotal connection of the bolt tightener with the carrier 23, the bolt tightener may be swung over upon the rear face of the annulus for protection thereby during blasting operations forwardly of the shield. Between the primary columns 8 and on the annulus may be laid a trackway 39 in line with a trackway 39x carried by the preformed rings of tunnel liner plates, and on this trackway there may be run up and into and through the shield a power mucker indicated generally at M, Figure 2. In the embodiment shown, the mucker comprises a frame having pivotally connected thereto a boom 40 which carries at its end the mucker bucket 41. The boom may be operated by means of cables, the hoist and swing cable being indicated by the dotted lines 42, Figure 2, each cable passing over one of two guide rollers 43 and thence each to its own hoist drum 44 or 44x as the case may be. Control levers for the hoisting drums and incidental brake bands are indicated at 45, the operator standing on the platform at 46.

The specific construction of the power mucker forms no part of the present invention and the illustration therefore is largely diagrammatic. In such devices the boom is mounted for both lateral swinging and rising and falling movements, and it is customary to provide a fifty degree lateral movement of the boom and for elevation of the boom and bucket to such point that the muck will drop downwardly by gravity onto an upwardly inclined endless belt as indicated at 47, from which it will pass to cars or other removal devices.

The passageway between the primary columns 8 will be sufficiently wide to permit the necessary lateral swinging movements of the power mucker boom and of sufficient height to permit the boom to rise in the shield as, for example, to the dotted line position shown in Figure 2. In operation, the power mucker may ride upon the shield itself in said passageway with the mucker boom projected forwardly thereof. As the shield is pushed forwardly and the muck pile formed in the usual manner, the power mucker will be operated forwardly of the shield, eliminating the usual shovel gangs. The position of the mucker will not interfere with the erection of any but the lowermost plates of the tunnel liner rings and when these plates are ready for insertion the mucker may be run back out of the shield and then returned to position. Also, where a rock face is being tunneled, the tunneling may proceed somewhat in advance of the shield and the power mucker moved ahead to clear the said lower area at which liner plates must be set and bolted together.

My method greatly reduces the costs of power shield tunneling as now universally followed by increasing the speed of operations, and reducing labor hazards. It will be understood that various changes may be made in the form of the power mucking shield and other devices illustrated in the drawings without departing from the spirit of the invention.

Having described my invention, what I claim and desire to secure by Letters Patent is as follows:—

1. A power-mucking shield for tunnels, com-

prising a face annulus having a cutting face and an interior girder and column reinforcement for said annulus, including an upper and a lower series of girders and columns, the lower series embodying columns bounding a mucker passageway extending from the base area of the shield centrally thereof upwardly to a point adjacent the shield axis.

2. A power-mucking shield for tunnels, comprising a face annulus having a cutting face and an interior girder and column reinforcement for said annulus and embodying columns connected to the annulus at its base and bounding a passageway adapted for the passage of a power-boom mucker, said passageway having a height permitting swinging of the mucker boom through said passageway of the shield from a point forwardly thereof to a point rearwardly thereof.

3. A power-mucking shield for tunnels, comprising a face annulus having a cutting face and an interior girder and column reinforcement for said annulus, consisting of a centrally disposed horizontal primary girder, opposed columns extending upwardly from the base of the annulus and supporting said girder, the said columns bounding a passageway for a power-boom mucker and adapted for swinging of the mucker boom upwardly for gravitational discharge of muck carried by a bucket at the end of the boom, and a series of girders and columns intermediate the upper area of the annulus and said primary girder.

4. A power-mucking shield for tunnels, comprising a face annulus having a cutting face and an interior girder and column reinforcement for said annulus, power jacks carried by the annulus, a trackway carried by the annulus adjacent its inner face, a carriage on said trackway, means intermediate the carriage and the trackway for moving the carriage longitudinally of the trackway, a bracket pivotally connected to the carriage and movable toward and from the rear face of said annulus and a bolt-tightening device connected to said bracket for universal movement relatively thereto.

5. A power-mucking shield for tunnels, comprising a face annulus having a cutting face and an interior girder and column reinforcement for said annulus, power jacks carried by the annulus, a trackway carried by the annulus adjacent its inner face, a carriage on said trackway, a bracket pivotally connected to the carriage, a second bracket having a swivel connection with the bracket, and a bolt-tightening device pivotally supported by said second bracket whereby the bolt-tightener is adapted for universal movement relatively to the carriage and may be swung over upon the rear face of the annulus for protection thereby during blasting operations forwardly of the shield.

6. A power-mucking shield for tunnels, having a face annulus having a cutting face and an interior girder and column reinforcement for said annulus including opposed sets of columns extending upwardly from the base area of the annulus and bounding a mucker passageway extending from said base area centrally thereof to a point adjacent the shield axis and removable breasting means carried by said columns comprising power jacks and a breasting girder connected to said jacks and capable of movement relatively thereto.

7. A power-mucking shield for tunnels, having a face annulus having a cutting face and an interior girder and column reinforcement for said annulus including opposed rigid columns extending upwardly from the base area of the annulus and bounding a mucker passageway extending from said base area centrally thereof to a point adjacent the shield axis and removable breasting means carried by said columns comprising power jacks, a breasting girder connected to said jacks and capable of movement relatively thereto, and a working platform slidably carried by said columns and connected with the breasting girder for movement therewith forwardly of the annulus.

8. A power-mucking shield for tunnels comprising a face annulus having a cutting face and an interior girder and column reinforcement, said reinforcement comprising a primary horizontal girder and a series of columns and girders connecting the same with the upper area of the annulus, opposed primary columns rising from the base area of the annulus and connected to the primary girder, said columns bounding a mucker passageway extending from the base area of the shield centrally thereof upwardly to a point below said primary girder, and a trackway carried by the annulus at the base of said passageway and adapted for movement by a power mucker through the shield.

LAURIE F. PARKER.